

REMARKS

Claims 1-62 are now in the application. Claims 1, 11, 34 and 53 have been amended by reciting “without a lithographic mask” for purposes of clarification and not to limit their intended scope. Support can be found, for example, at column 2, lines 51-54; column 3, lines 1-3; and column 7, lines 22-30. Claims 1 and 16 have also been amended to correct the spelling of “said” for purposes of clarification and not to limit their scope. In addition, claim 1 has been amended to recite “outside of said at least one recess” as apparently suggested by the Examiner for purposes of clarification. Claim 1 has also been amended to recite “and in said at least one recess” to provide the antecedent basis for “removing photoresist remaining in said recesses. This amendment to claims 1 and 16 address the objection to these claims. Claims 3, 7, 30 and 49 have been amended to recite “layer of tantalum on said tantalum nitride layer” in place of “layer including the nitride of tantalum” for purposes of clarification. The amendments to the claims and drawing do not introduce any new matter.

The objection to the drawings has been addressed by the amendments to Figure 3. In particular, Figure 3 has been amended by deleting “4” and inserting “11”. Also, the objection to claims 1 and 16 has been overcome by the above amendments to the claims.

The rejections claims 1-62 were rejected under 35 USC 112, first paragraph and 35 USC 112, second paragraph have been overcome by the amendments to the claims and/or are not deemed tenable. For instance the rejections based upon the use of the recitation “without utilizing a mask” has been overcome by the amendments to claims 1, 11, 34 and 53 to recite “without a lithographic mask”. With respect to the rejection of claim as lacking support in the specification, claim 5 is an originally filed claimed of USSN 09/389,232 which matured into US Patent 6,297,140. Originally filed claims are considered part of the original disclosure. Therefore, claim 5 is supported by the original disclosure and is proper.

Claims 1, 5, 6 9, 14-17, 22, 24, 36, 38, 39 and 55 were rejected under 35 USC 102 (e) as being anticipated by US Patent 6,025,275 to Efland et al. (hereinafter also referred to as “Efland”). Efland does not anticipate claims 1, 5, 6 9, 14-17, 22, 24, 36, 38, 39 and

55 since, among other things, Efland does not disclose electroplating a second metal to the plating seed layer without utilizing a lithographic mask.

In particular, Efland first forms and buries a seed layer (e.g. Fig. 1D, layer 32) in order to perform electroplating of the solder or bump metals. This means Efland must subsequently strip the masking films 62, 60 and strip this seed layer from non-plated regions, as in his Fig. 1E. This is a difficult and costly process. This step is avoided according to the present invention by selectively removing the seed layer from non-recessed areas prior to plating, so that only the barrier layer is exposed. The plating only occurs on the non-removed seed layer areas. There is then no requirement to add process steps to remove any masks or exposed seed layer. Please see Fig's. 1 - 3. Furthermore, Efland requires a (photolithographic) masking layer 62.

The present invention, as mentioned above, relates to a process without the steps of exposing a layer of photoresist on the substrate to a mask pattern using a photolithographic system and a separately designed photomask. This is a costly process sequence which is eliminated in the present invention. According to the present invention, a self-aligned metal capping technique is provided for coating the surfaces of, for example, Cu pads on a semiconductor substrate, using the selective properties of electrolytic Cu plating and alternative techniques to cause it to plate only on the Cu pad surfaces. Normally a lithographic masking level would be used to protect non-Cu pad regions from plating.

Claims 1, 2, 14, 16-18, 22, 24, 15, 36, 38-40, 44, 55 and 57-59 were rejected under 35 USC 102 (b) as being anticipated by US Patent 5,010,389 to Gansauge et al. (hereinafter also referred to as "Gansauge"). Gansauge does not anticipate claims 1, 2, 14, 16-18, 22, 24, 15, 36, 38-40, 44, 55 and 57-59 since, among other things, Efland does not disclose electroplating a second metal to the plating seed layer without utilizing a lithographic mask.

In particular, Gansauge also uses two photolithographic patterning to achieve the structure suggested therein (please see layers 22 and 24 in Fig's. 2 - 6). Also, Gansauge requires part of the insulator to remain under the solder bump. Clearly this is not required in the present invention. (Please see Fig. 3).

Column 5 lines 15-18 of Gansauge states as follows:

In FIG. 2 a polymeric layer 22, e.g. polyamide is arranged over the conductive barrier-seed layer 20 and removed by a lithographical process in the areas of the terminal vias. The thickness of the polymeric layer 22 is -----.

Claims 13-8 and 26 were rejected under 35 USC 103 (a) as being obvious over US Patent 6,025,275 to Efland et al. in view of European Patent EP 0 751 566 A2 to Cabral, Jr. et al. The cited references do not render obvious claims 13-8 and 26. Cabral, Jr. et al was relied upon for a disclosure of depositing a layer of α -Ta on TaN. Cabral, Jr. et al do not overcome the above discussed deficiencies of Efland with respect to rendering unpatentable the present invention. Therefore claims 13-8 and 26 are patentable for at least those reasons as to why the generic claims are patentable.

Claim 13 was rejected under 35 USC 103 (a) as being obvious over US Patent 6,025,275 to Efland et al. Claim 13 is deemed to be patentable for at least those reasons as to why the generic claims are patentable.

Claims 19, 41 and 60 were rejected under 35 USC 103 (a) as being obvious over US Patent 6,025,275 to Efland et al. in view of US Patent 5,010,389 to Gansauge et al. The cited references do not render obvious claims 19, 41 and 60. Gansauge et al. was relied upon for a disclosure of an insulating layer of polyimide. Gansauge does not overcome the above discussed deficiencies of Efland with respect to rendering unpatentable the present invention. Therefore claims 19, 41 and 60 are patentable for at least those reasons as to why the generic claims are patentable.

Claims 12, 35 and 54 were rejected under 35 USC 103 (a) as being obvious over US Patent 6,025,275 to Efland et al. in view US Patent 5,736,456 to Akram. The cited references do not render obvious claims 12, 35 and 54. Akram was relied upon for a disclosure of CMP. Akram does not overcome the above discussed deficiencies of Efland with respect to rendering unpatentable the present invention. Therefore claims 12, 35 and 54 are patentable for at least those reasons as to why the generic claims are patentable.

In view of the above, consideration and allowance are, therefore, respectfully solicited.

In the event the Examiner believes an interview might serve to advance the prosecution of this application in any way, the undersigned attorney is available at the telephone number noted below.

The Director is hereby authorized to charge any deficiency in the fees filed, asserted to be filed or which should have been filed herewith to our Deposit Account No. 22-0185, under Order No. 20136-00272-US.

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